Build Your Own Robot

BY TOM CARROLL

Photographs by Roger Morgan

Don't just dream about having a robot. Build one yourself. Here's how.

EVER WISH YOU HAD YOUR OWN robot? Lots of people do. But to buy a good one, you'd have to spend several hundred dollars. For less than $50, however, you can build one yourself.

Meet GISMO2BL, son of famous "GISMO the Great," the lanky robot whose life story first appeared in *Boys' Life* in 1956.

GISMO2BL is more compact and streamlined than his old man. He's shorter too, the better to fit in a spacecraft should NASA ever want to launch him into orbit.

What can GISMO2BL actually *do*? The robot shown here can move around at your command and also move his arms. You can make him do other things too, the only limit being your own skill and imagination.

We'll show you how to build the basic robot and where to go for more information about the exciting science of robotics.

First, a few words about GISMO2BL's anatomy. His body is a plastic wastebasket. His head is a small metal-and-plastic box that turns on a lazy Susan bearing. His arms are plastic (PVC) sprinkler pipe and flexible hose. His hands are wooden claws or bent coat-hanger wire.

GISMO2BL's guts are four motors (actually, two dual motors) taken from the Milton Bradley "Big Trak" toy tank (or available separately from the address below).

One of the dual motors, mounted on a plywood base, turns the robot's two main wheels—independently of one another so that he can turn on a dime. The other motors, mounted above the plywood base in the end of the wastebasket, rotate his arms, also independently. You operate the motors with a four-switch hand controller attached to the robot with a controller cable.

You can make GISMO2BL fancier if you wish. Try adding lights for his eyes, and a walkie-talkie in his head for a voice. Visit a model-airplane store and figure out how to make your robot totally *radio*-controlled.

Another option is to computerize GISMO2BL. For example, use the tiny computer from a working "Big Trak" as a controller. It receives signals from the Big Trak motors, which have a special encoder that allow the computer to know how far the arms and wheels have moved. Or make your robot programmable with an inexpensive surplus Timex-Sinclair computer that will fit inside. (See books listed below for tips.)

Here's what you'll need to get started:

1) two six-volt Big Trak motors at $4.95 each	$9.90*
2) two plastic wheels at $1.50 each	$3.00*
3) plastic wastebasket	$3.98
4) battery holder for four "D" cells (Radio Shack #270-389)	$1.29**
5) "head" box (plastic/aluminum) (Radio Shack #270-232)	$2.99**
6) hand controller box, 4-by-2-by-1 3/16 inches (Radio Shack #270-220)	$1.69**
7) four controller-box DPDT miniature switches at $2.89 (any DPDT "center-off" switch will work)	$11.56**
8) controller cable (25 conductor, split in half) (Radio Shack #278-772)	$3.59**
9) terminal strip (should have 10 or more positions)	$1.69**
10) two small screw-mounted casters at $1.50	$3.00
11) three-inch lazy Susan bearing	$2.00
12) two 45-degree sprinkler pipe fittings at 39 cents	$0.78
13) two 90-degree sprinkler pipe fittings at 39 cents	$0.78
14) four eight-inch sections of sprinkler pipe	$1.00
15) two 12-inch sections of pool or vacuum hose	$1.00
16) miscellaneous: plywood (for base), batteries, screws, wood blocks, wire and tape	
TOTAL	$48.25

* Available at H&R Corporation, 401 E. Erie Ave., Philadelphia, PA 19134. (Mention the *Boys' Life* robot, and include $2.50 postage, for a special minimum purchase agreement for *Boys' Life* readers.)

** Available at Radio Shack stores everywhere.

Now, let's begin.

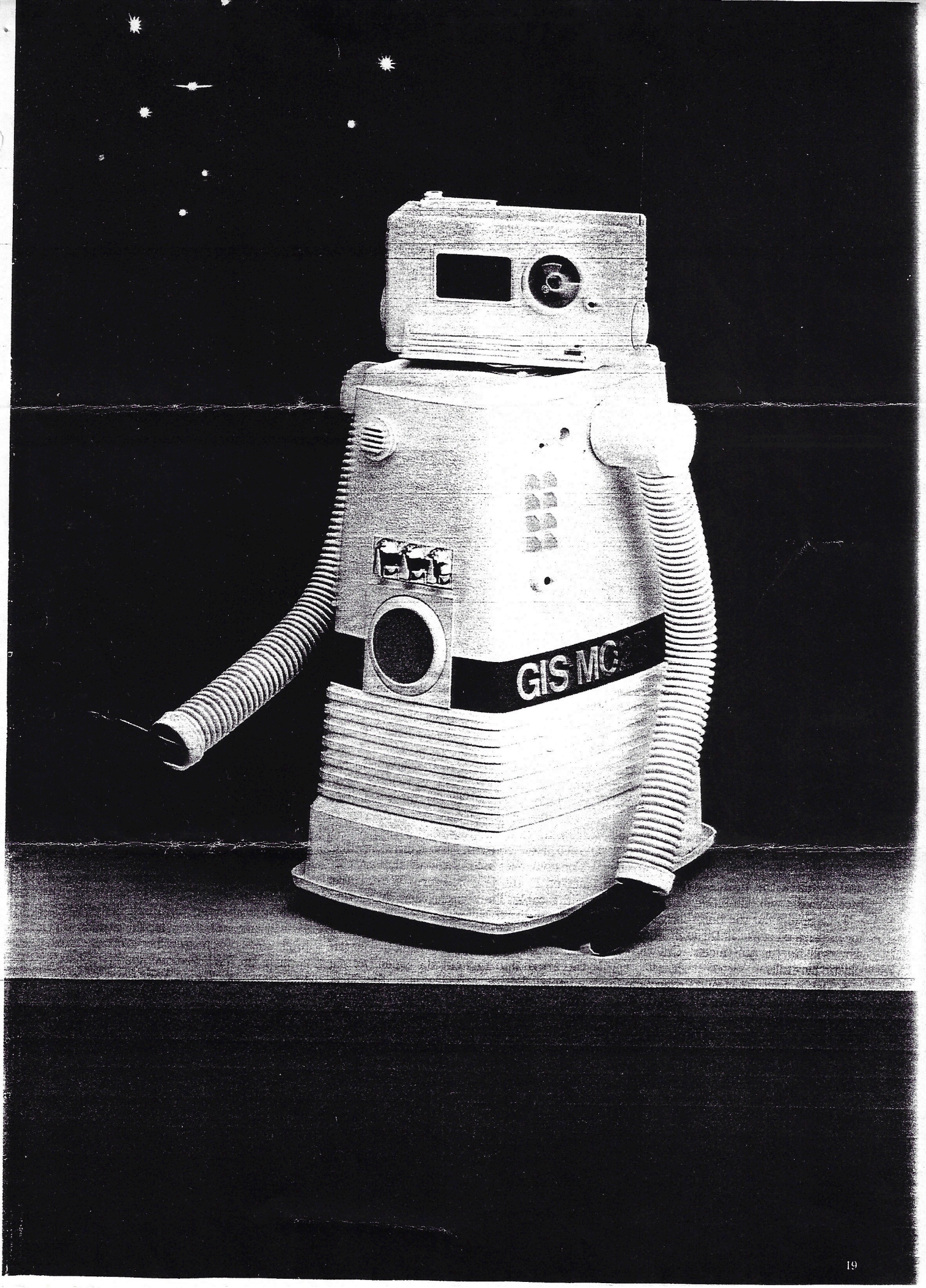
1. Lay out all of your materials on a table. Use a pencil to trace the outline of the wastebasket opening onto the plywood. Cut the base so that it fits snugly *inside* the edge of the wastebasket, so the wood won't show. Cut slots in the base for the caster wheels (at the front and back) and the main wheels (at the sides).

2. Mount a dual motor on the base and attach the main wheels to its axles.

3. Cut and bend brackets with metal from a tin can to make holders for the little caster wheels. Position them so the wheels reach down about one-sixteenth of an inch *less* than the main wheels. This will make the robot rock slightly, allowing the main wheels to contact the floor at all times.

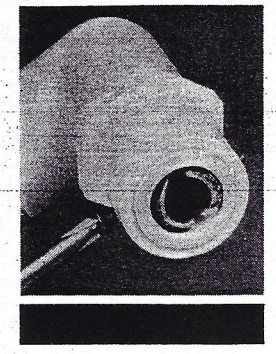
4. Construct the arms. Cut the PVC segments to desired length and press fit them into the joints you bought. (Don't glue—you may want to change their positions later.)

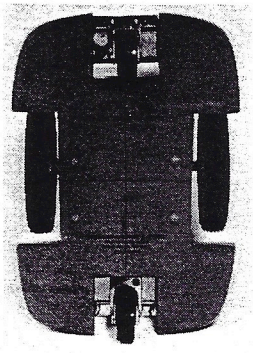
5. Mount the arm motor assembly. Turn the wastebasket over and position the motor. Use small machine screws, with metal spacers or wood blocks to hold the


GIS MC

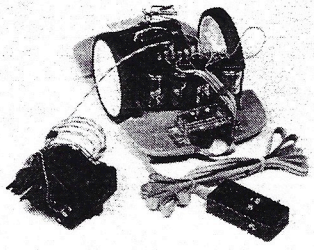
CAROL PEASE

At left, the author's sons, Jim (far left) and Tom, work on their robot at their home in California. Below: Devise a shoulder joint for joining arm to motor shaft.

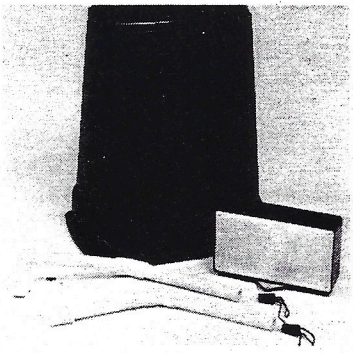




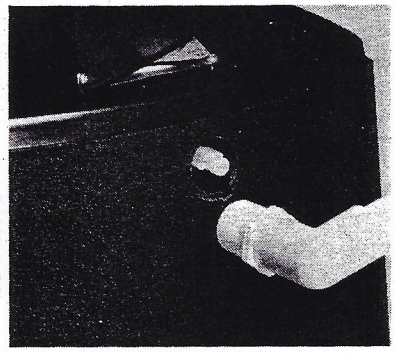
Plywood base should be cut to accommodate the drive wheels and the caster wheels.



Pictured here is the base with attached drive motor, arm motor and hand controller.



Robot body parts: wastebasket, plastic-and-metal box (for head), plastic pipe pieces (for arms).



Arms connect to arm motor shafts through holes cut in wastebasket.

motor away from the wastebasket bottom (robot's top). Later, you may want to run wires or a motor shaft through the "neck," so you might need that extra space.

This is a good time to attach the neck bearing assembly and the head box.

6. Use an ice pick to puncture the sides and to mark the points where the arm motor shafts will come out.

7. Carefully cut the holes, large enough for the arm pieces to fit through. A circular saw will do the job nicely. Cut the soft plastic carefully.

8. Devise a way to attach the arms to the arm motor shafts. There are several possibilities. Try lightly taping the arm motor shafts to make them larger, or glue a smaller piece of pipe inside the shoulder joint to make the motor shaft fit more snugly. A screw through the side of the shoulder joint will hold the arm onto the motor shaft.

You may also want to loop a large rubber band over this fitting and fasten it to the body. It will act as a spring to help the arms move upward.

9. Mount the battery box to the inside of the wastebasket or to the base (as shown). Remember to leave room to insert the batteries. Mount the terminal strip (in the photo, it sits on the battery holder). Wire the battery holder to the terminal strip (with two wires) and then attach the screws from the two dual motors.

10. Now construct the hand controller. The controller holds switches that are connected to the terminal strip in the robot with a cable. The switches control the flow of electricity to the motors.

Four switches go inside the box. Two will stick out the top of the box (to operate the arms) and two out the sides (for the wheels). Position them where they'll be comfortable to operate, and drill holes in the box accordingly.

Before installing the switches, wire them as shown in the diagram. (It's not as difficult as it looks.) With some types of switches, you'll have to do some soldering. To avoid soldering, select the larger double-pole, double-throw (DPDT) switches that use screw-on terminals.

Consider saving room for extra switches in case you add other functions, such as lights, tape player or other motors.

11. Connect the eight wires from the switches in the controller to the terminal strip. This should complete the wiring.

12. Assemble the robot. Add the batteries and check motor function. Attach the base to the wastebasket with small wood screws.

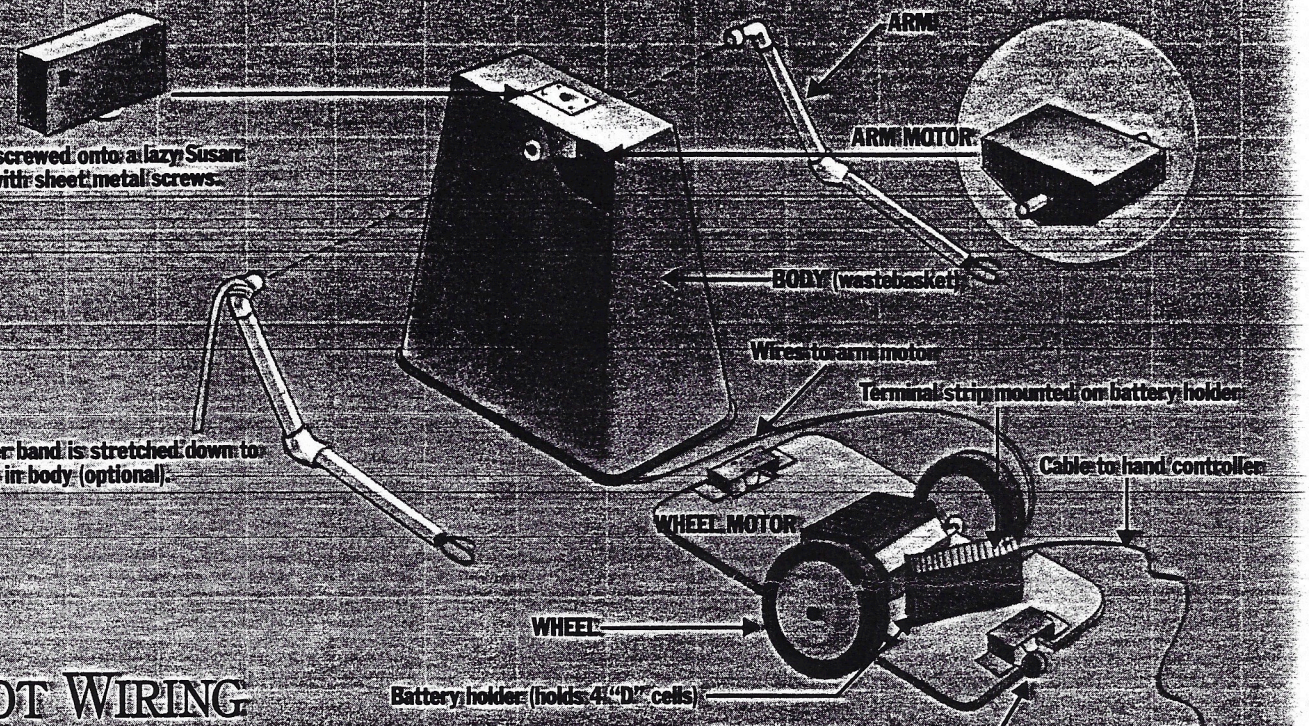
13. Your basic robot is complete at this point. Now it's time to dress him up however you like. Be prepared to change your creation as you discover more tasks you want him to do.

For more power, you might substitute a six-volt lantern battery for the D cells. Try other ideas of your own. For guidance, read some of the TAB book company's robotics books such as "Build Your Own Working Robot" or the two robotics handbooks by Edward Safford. The Howard Sams Book Company paperback entitled "Microprocessor Based Robotics" by Mark Robillard will give you an advanced look at robotics.

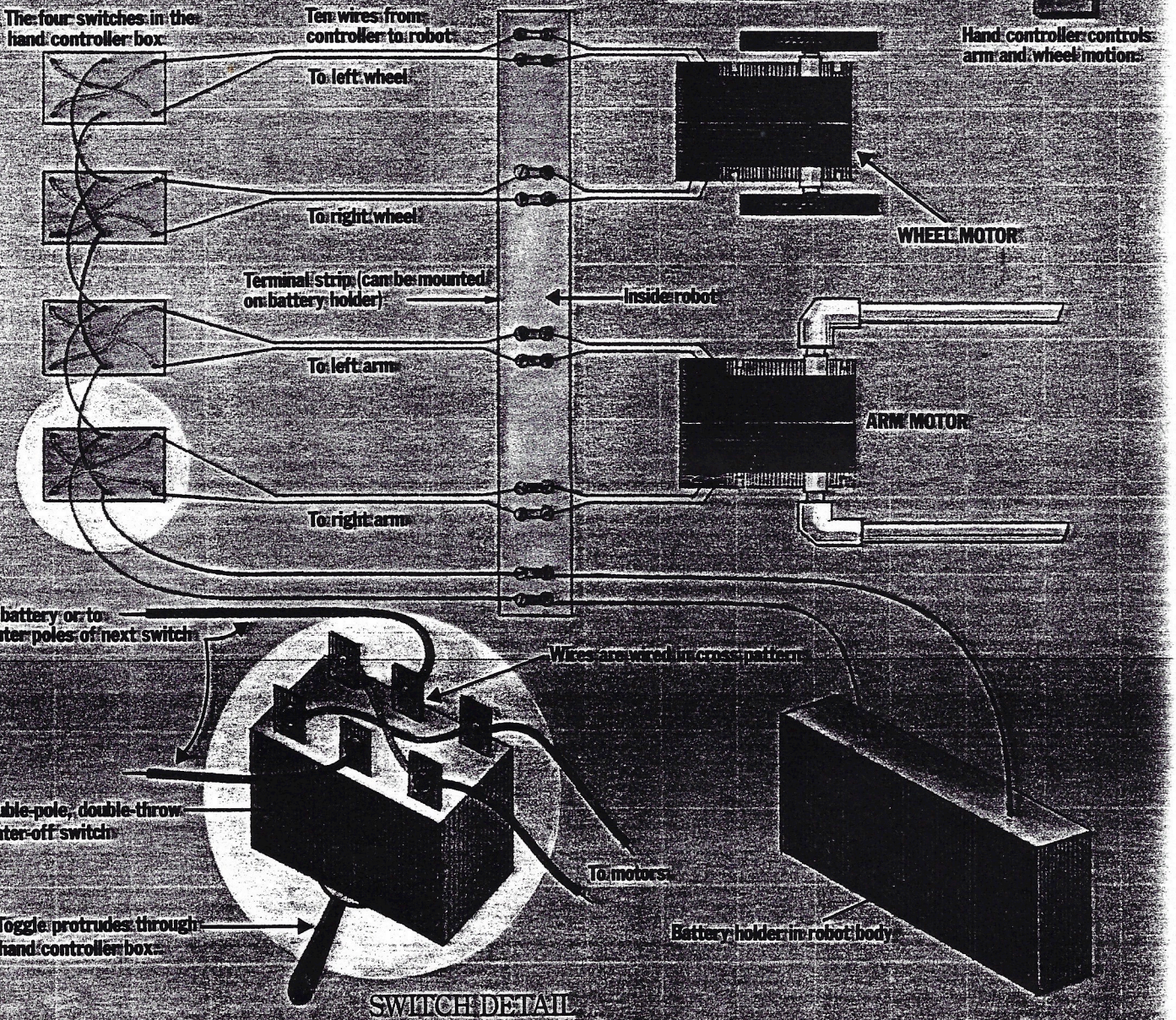
Radio Electronics magazine has a regular column on robotics by Mr. Robillard. *Robot Experimenter,* 174 Concord St., Peterborough, NH 03458, is an excellent publication for home builders. Talk with computer buffs about how to connect a computer to your machine. Give robotics a try. A more rewarding hobby you'll never find.

I hope you enjoy your little robot as much as my sons and I enjoy ours.

ROBOT ASSEMBLY


HEAD is screwed onto a lazy Susan bearing with sheet metal screws.
ARM
ARM MOTOR
BODY (wastebasket)
Wires to arm motor
Terminal strip mounted on battery holder
Rubber band is stretched down to screw in body (optional).
Cable to hand controller
WHEEL MOTOR
WHEEL
Battery holder (holds 4 "D" cells)
CASTER WHEEL

ROBOT WIRING


The four switches in the hand controller box
Ten wires from controller to robot
To left wheel
To right wheel
Terminal strip (can be mounted on battery holder)
Inside robot
To left arm
To right arm
Hand controller controls arm and wheel motion
WHEEL MOTOR
ARM MOTOR
To battery or to center poles of next switch
Wires are wired in cross pattern
Double-pole, double-throw center-off switch
To motors
Toggle protrudes through hand controller box
Battery holder in robot body

SWITCH DETAIL